Environment Canada
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Inland Waters Directorate
Western and Northern Region

Direction générale des eaux intérieures
Région de l'ouest et du nord

90-06697/

USERS GUIDE:

1990 MACKENZIE RIVER STAGE FORECAST

J.N. Jasper
Studies & Hydrology
Yellowknife, NWT

N.W.T. Programs
Inland Waters Directorate
Conservation & Protection
Western & Northern Region
Environment Canada

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Preface

This guide is designed to inform users of Inland Waters Directorate's Mackenzie River Stage Forecast on the hydrometric (water level) observation network, data reporting and analysis, and the forecast distribution process, as well as to provide samples of the forecast and an illustration of it's accuracy.

The forecast is produced by Yellowknife staff of the NWT Programs office, Inland Waters Directorate, Environment Canada early each weekday morning (and on weekends during high flow events), utilizing internally-produced hydrometric data as well as meteorologic data and forecasts by the Yellowknife Atmospheric Environment Service office of Environment Canada. The forecast will be distributed by FAX or Telex to forecast clients, including Transport Canada, the Government of the Northwest Territories, Esso Resources and barge transport companies, by 08:30 each reporting day, for use in the day-to day planning and operations of river-based activities.

The assistance, in the form of data, interpreted weather information or forecasts, and advice, of the following individuals or agencies is gratefully acknowledged: Gary Burke and weather briefers of the Atmosphere Environment Service of Environment Canada and contracted observers and Water Survey of Canada field technical staff of the Inland Waters Directorate. Thanks are also due to Paul Squires, Chris Heron and Marcia Marsollier of the NWT Programs office, Yellowknife for their assistance in producing this guide.

Notice

The Northwest Territories portion of Canada's largest watershed, the Mackenzie River basin, is remote and contains few hydrometric and weather stations. Availability of data and the technically rudimentary nature and capabilities of current procedures severely restrict accuracy of the forecast, especially during high flow events. Forecast users should therefore interpret the effects of the forecast on their river activities with caution.

Additional Copies of this report are available from:

Chief, NWT Programs
Inland Waters Directorate
Conservation & Protection
Environment Canada
P.O. Box 2970
Yellowknife, N.W.T.
X1A 2R2

1990 MACKENZIE RIVER STAGE FORECAST USERS GUIDE

Introduction

The Mackenzie River Stage Forecast is produced by the Inland Waters Directorate (IWD), Environment Canada (EC), Yellowknife, as part of an agreement with the Canadian Coast Guard (CCG), Transport Canada (TC). Daily water levels for seventeen hydrometric stations (see Figure 1) are used to provide forecast users with current readings for eight primary locations, as well as a 3-day forecast for three critical locations (i.e. Norman Wells for Esso Resources oilfield operations; Sans Sault Rapids and the Ramparts at Fort Good Hope for river barge operators). Current water levels in the South Nahanni River basin are also provided to the Canadian Parks Service (CPS), EC as a related service for users of Nahanni Park.

Observation Network

The hydrometric (water level) observation network operated by Water Survey of Canada (WSC), Inland Waters Directorate, Environment Canada, means of data retrieval, and responsibilities for the operation and maintenance of on-site equipment used in the forecast are as follows:

Station (Mainstem/-Tributary)	Data Retrieval	WSC Office
1. Great Slave Lake at Yellowknife Bay	IWD Personnel	Yellowknife
2. Mackenzie River near Fort Providence	DCP	Ft.Smith
3. -Liard River at Lower Crossing, B.C.	DCP	Ft.St. John
4. -Liard River near Fort Liard	Observer/Telemark	Ft. Simpson
5. --South Nahanni River above V.Falls	DCP	Ft. Simpson
6. -Liard River near the mouth	DCP	Ft. Simpson
7. Mackenzie River at Fort Simpson	Telemark	Ft. Simpson
8. -Root River near the mouth	DCP	Ft. Simpson
9. Mackenzie River near Wrigley	DCP	Ft. Simpson
10. -Redstone River 63km above the mouth	DCP	Inuvik
11. Mackenzie River at Norman Wells	DCP	Inuvik
12. -Carcajou River below Imperial River	DCP	Inuvik
13. -Mountain River below Cambrian Creek	DCP	Inuvik
14. Mackenzie River at Sans Sault Rapids	DCP	Inuvik
15. Mackenzie River at Fort Good Hope	Observer	Inuvik
16. Mackenzie River at Arctic Red River	DCP	Inuvik
17. Mackenzie River (East Ch.) at Inuvik	DCP	Inuvik

* Observers - paid by IWD; DCP - satellite transmitting data collection platform; Telemark - telephone-accessible site

The Yellowknife Atmospheric Environment Service (AES) office, Environment Canada also provides daily weather summaries and forecasts for the stage forecast area to IWD, based on data from AES, Transport Canada, and GNWT Forestry fire weather networks.

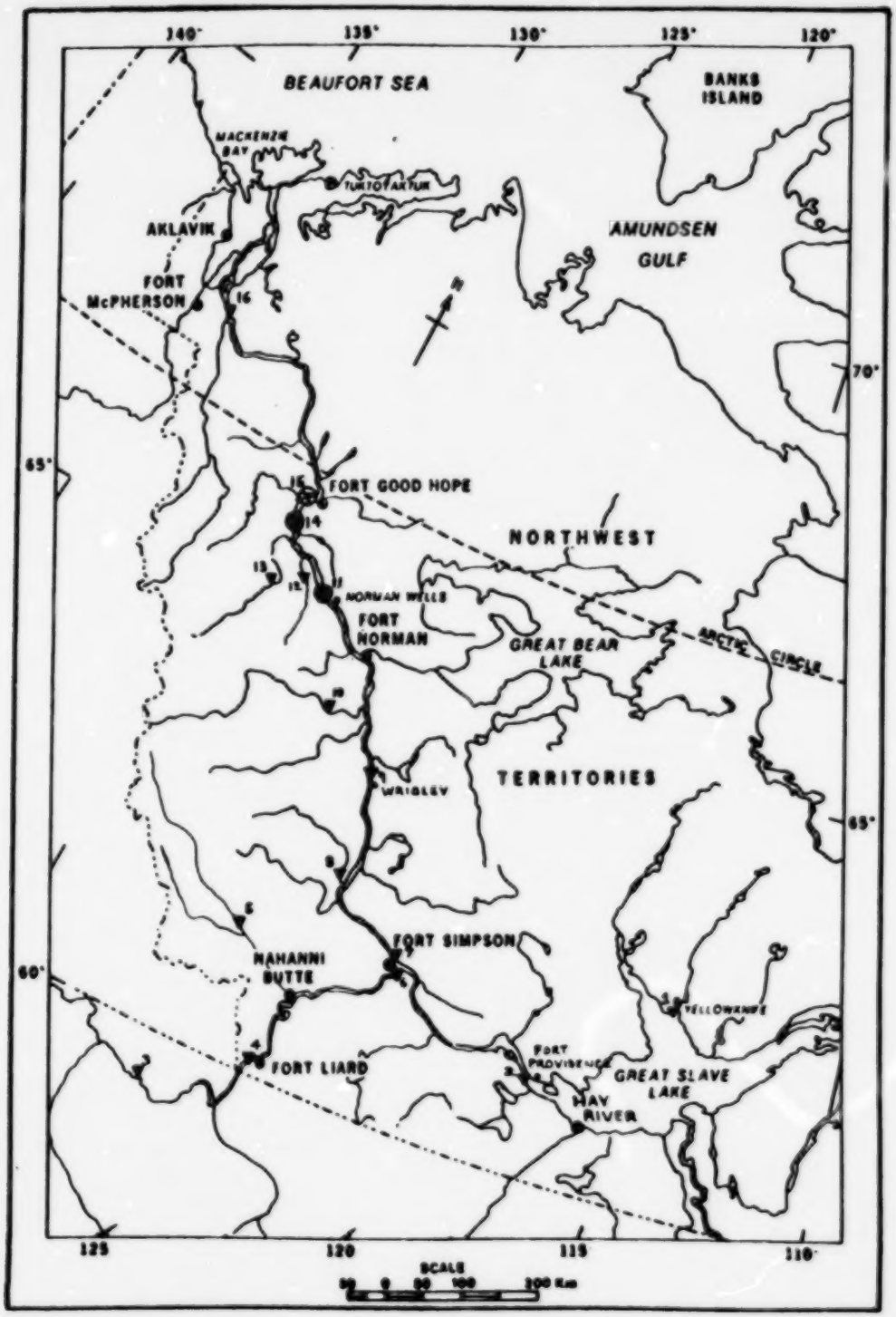

Figure 1: Observation Network for 1990 Mackenzie River Forecast
forecast reporting sites •
forecast stations ⊕

This information, particularly any advisories or warnings on extreme weather, is useful in forecasting and reacting to major summer floods, and will be passed along to Mackenzie River forecast users via the forecast sheet.

Forecast Data Collection, Analysis, and Reporting Structure

Figure 2 depicts the flovchart of information sources, activities, and responsibilities required to produce and distribute the Mackenzie River Stage Forecast. Rav data used in the forecast includes hydrometric (vater level) and meteorologic (weather; especially rainfall) measurements.

The hydrometric data are generated in near real-time by automatic stations transmitting hourly readings to Environment Canada's Vancouver satellite data receiving station every three hours. The previous 24 hours of transmissions are obtained each morning by the Yellovknife IVD Office Mackenzie Forecast staff for use in analyzing trends and producing the forecast. Observers and telephone-line accessible sites (i.e. Telemark installations) are also queried for additional data. If problems arise due to non-reception of data or questionable results, IWD, WSC staff responsible for normal hydrometric netvork operations are contacted for special forecast station servicing.

For the 1990 forecast season, the AES veather office vill summarize daily meteorologic readings from the AES/Transport Canada and GNWT Forestry netvorks in the form of a lover Mackenzie Basin veather map. National and regional scale analyses of upper air data vill also be monitored for conditions indicative of extreme veather events, and a summary of the previous days precipitation information provided vith a 36-hour forecast to IWD, as input to the Mackenzie River Forecast.

The current forecast system is a simple graphically-based procedure, vherein vater levels at all sites are recorded daily on multi-plot graphs (more often under quickly changing conditions) to shov the trend of vater levels. Forecasts of river stage for the next 3 days at the three forecast sites involve a simple linear extension of the past trend, vhen flovs are stable or declining. This qualitative or judgemental approach must also be used for forecasting under increasing stage (flood) conditions, due to the current absence of more rigorous analytical procedures (or models) for routing of such events on the Mackenzie River. As can be expected, the accuracy of this forecasting approach suffers vith the magnitude of such floods and the rate of rise in vater levels (see July 1988 flood; Figure 5). With the forecast being updated each veek day, and as required on veekends, adjustments are made vhen the forecast diverges from observed conditions, in order to bring the forecast back on track.

Detailed information on agencies and staff involved in the forecast, including the names and telephone numbers of data sources, field staff, the IVD Yellovknife Mackenzie Forecast staff, and forecast users, is provided in the Appendix. Examples of a completed Mackenzie River Stage Forecast data report sheet (Figure 3) and a forecast telex as sent to users (Figure 4) are also provided.

Note the checkoff confirmation of telexes or faxes sent on the data report sheet (Figure 3) and the commentary part of the forecast telex, covering stage and veather information (middle part of Figure 4).

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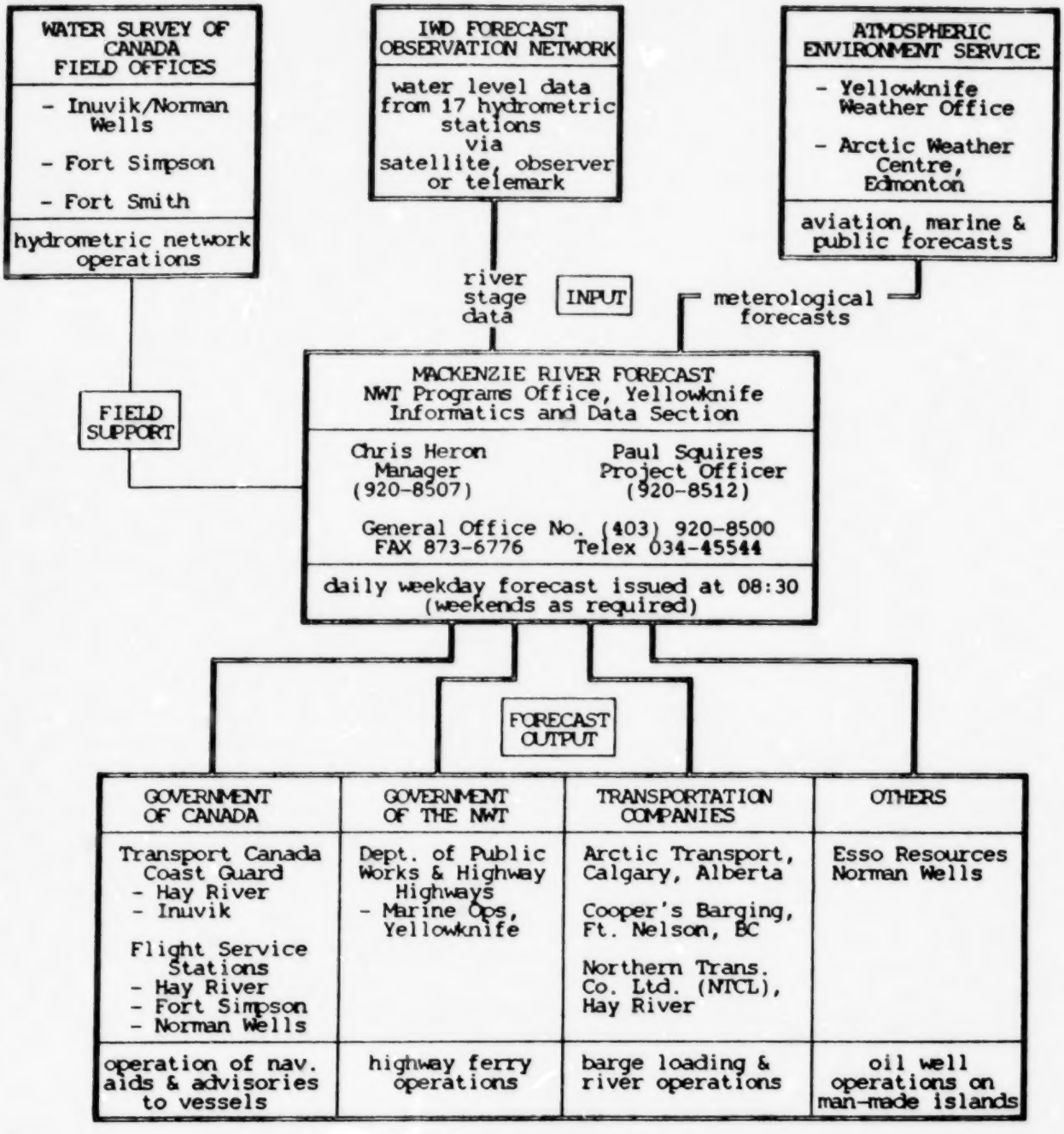
Figure 2. MACKENZIE RIVER STAGE FORECAST

FLOWCHART



Canada

JUNE 1990

Response to High Flow Events

Forecast users should be avare that the current forecast process is severely limited in it's ability to provide accurate, timely forecasts of high flow events on the Mackenzie River. Maintenance of gauging stations is difficult, due to widely fluctuating mountain tributaries, site conditions at the Wrigley station (receding water levels expose the gauge sensor in shallow water, high flows wash out sensor, etc.) and other problems, and the high cost of special trips to repair or maintain forecast stations. Due to the absence of a calibrated flow routing model to handle known existing conditions on the river, all forecasting and much of the data handling must still be done manually, based on forecaster's judgement.

An initial IWD evaluation of possible operational improvements is underway, including the various data retrieval, data processing and analyses, flow routing and other models (i.e. precipitation/runoff) required for systematic forecast improvement. When technical and operational options and constraints have been thoroughly examined, the needs of Transport Canada and the river user community will be discussed, and a long term plan for improvement of the forecast developed.

Interim measures to improve the accuracy and responsiveness of the 1990 forecast to high flow events include this guide to the forecast, organizational changes (naming of contacts, weekend duty rosters, etc.), a companion guide on IWD's internal response to floods (including alerting of emergency response officials, etc.), and changes in the monitoring of realtime data sources. Other improvements will follow throughout the season as they are developed and implemented (i.e. a special AES weather summary, forecast, and weather map for use in producing the Mackenzie River Forecast; weekly distribution of a plot of past, current and forecast water levels at the primary forecast stations to users; etc.). Forecast users will be kept advised of these developments via the stage forecast (see bottom of Figure 4).

General information on forecast responsibilities and weekend or after-hours contacts in Inland Waters Directorate are as follows:

a) **Primary Weekday Contact:**

Paul Squires - Project Officer responsible for forecast
Telephone 920-8512 (873-2464 after hours);
FAX 873-6776; Telex 034-45544

b) **Forecast Supervisor:**

Chris Heron - Overall responsibility for forecast service
Telephone 920-8507;
FAX and Telex as above

c) **Weekend Contacts:**

The name and contact information for weekend forecast service during high flow events will be provided each week (if necessary) on the Friday forecast.

For emergency situations, see Emergency Preparedness Canada's Emergency Call for Alberta/NWT Region (Appendix; Table A2).

Figure 3: Completed Mackenzie River Stage Forecast Data Report Sheet

MACKENZIE RIVER STAGE FORECAST 1990

REPORT SHEET

Date: June 2/90 Report No.: 2 Time: 07:30

TELEX:
A) FSS Hay River Unable to contact 034-4315 C) NTCL Hay River FAX ✓ ~~034-4219~~
I) CGRS Inuvik ✓ 034-44589 K) FSS Norman Wells ✓ 034-46539
Auto 1) FSS Ft. Simpson ✓ 034-4335

FAX: All on One Touch Button 01, or individual Speed Dial

Speed Dial #	User	Full Fax Number
	Water Survey (Inuvik, Ft. Simpson)	✓
17	Esso Resources, Norman Wells	587-3270 ✓
34	Coopers Barging, Fort Nelson	(604) 774-6744 ✓
35	Coast Guard, Hay River	874-5508 ✓
36	Arctic Transport, Calgary	264-9972 ✓

STATION	OBSERVED DATA Day/Mth	Time	Stage	Datum	FORECAST DATA Day/Mth	Stage
Great Slave Lake at Yellowknife						
Fort Providence	02/06	NOT	WORKING			
Fort Simpson	02/06	0645	7.42			
Wrigley	02/06	NOT	YET INSTALLED			
Norman Wells	02/06	0646	5.791		03/06	5.83
					04/06	5.95
					05/06	6.20
Sans Sault	02/06	NOT	YET INSTALLED			
Fort Good Hope	02/06	NOT	YET AVAILABLE			
Arctic Red River	02/06	0440	7.244			
Inuvik	02/06	0554	4.630			
Liard River at Fort Liard	02/06					

Remarks:

Figure 4: Mackenzie River Stage Forecast Telex/Fax to Users

ENVIRONMENT CANADA, WATER SURVEY OF CANADA

1990 MACKENZIE RIVER STAGE FORECAST

--- 26TH SEASON 1965 - 1990 ---

DATE : JUNE 2, 1990 REPORT NO. 2 TIME : 0730

	OBSERVED DATA				FORECAST DATA	
	DAY/MTH	TIME	STAGE	DATUM	DAY/MTH	STAGE
FT PROVIDENCE	02/06	NOT WORKING				
FT SIMPSON	02/06	0645	7.42			
WRIGLEY	02/06	NOT YET AVAILABLE				
NORMAN WELLS	02/06	0646	5.791		03/06	5.83
					04/06	5.95
					05/06	6.20
SANS SAULT	02/06	NOT YET AVAILABLE				
FT GOOD HOPE	02/06	NOT YET AVAILABLE				
ARCTIC RED R	02/06	0440	7.244			
INUVIK	02/06	0554	4.630			
LIARD R/FT LIARD	02/06	0745	9.012	HEAVY DEBRIS		

STAGE REPRESENTS WATER DEPTH IN METRES.
FOR FURTHER INFORMATION CALL CHRIS OR PAUL AT (403)920-8507 OR 8512.

AES REPORTS CONDITIONS WILL REMAIN GENERALLY SUNNY WITH LIGHT WINDS OVER THE FORECAST REGION WITH LOCAL FOG PATCHES IN THE MORNINGS AND SOME AFTERNOON CLOUDINESS NEAR FT. SIMPSON. TEMPERATURES WILL SLOWLY RETURN TO NEAR AVERAGE BY SUNDAY. SOME CHANCE OF SHOWERS IN THE LIARD VALLEY TODAY.

THE HIGH STAGE ON THE NAHANNI RIVER CAUSED BY THE HEAVY RAINFALL HAS PEAKED DURING THE NIGHT AND IS NOW FALLING. THE STAGE ON THE LIARD RIVER CONTINUES TO RISE ALONG IT'S LENGTH, AND THIS IS NOW AFFECTING THE MACKENZIE AT FORT SIMPSON. HEAVY DEBRIS AND TREES ARE REPORTED BY THE OBSERVER IN FORT LIARD. EXPECT THIS HIGHER WATER TO AFFECT STAGE AT NORMAN WELLS 24-36 HOURS.

WSC YELLOWKNIFE WILL CONTINUE TO WATCH STAGE ON LIARD OVER WEEKEND.

WSC OFFICE IN INUVIK REPORTS THAT THE RIVER IS OPEN AND CLEAR OF ICE TO THE LOWER DELTA AS OF 1200 MDST JUN 01, 1990.

NWT HIGHWAYS REPORTS THAT THE MACKENZIE FERRY AT FORT PROVIDENCE IS CLOSED AS OF 0830 JUNE 01 DUE TO ICE IN THE RIVER. NO FURTHER UPDATE HAS BEEN RECEIVED.

--- CHANGES TO THE 1990 MACKENZIE STAGE FORECAST ---

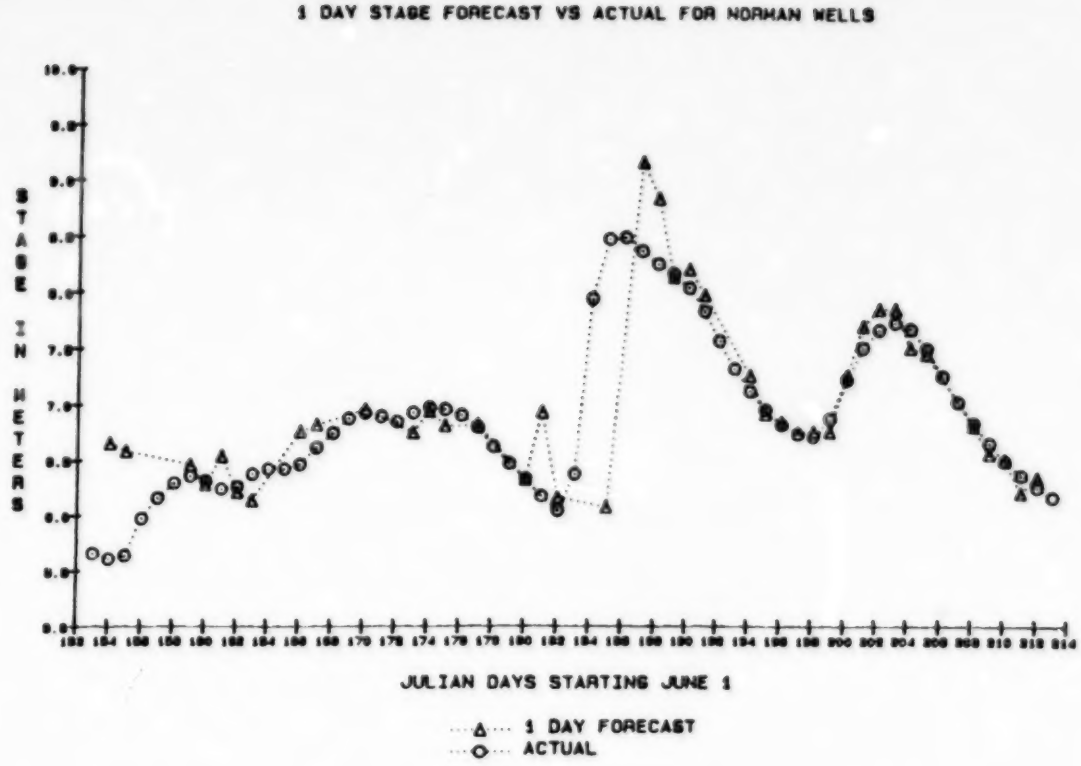
1) WATER SURVEY WILL BE TRYING TO PRODUCE THE REPORT EARLIER IN THE MORNING TO REACH RADIO SCHEDULES OF VARIOUS USERS.

2) STAGES AT ARCTIC RED RIVER AND INUVIK WILL BE REPORTED DAILY.

3) A WEEKLY GRAPH OF THE STAGE ON THE MACKENZIE AT NORMAN WELLS, SANS SAULT AND FORT GOOD HOPE WILL BE ISSUED TO INTERESTED USERS BY FAX EACH FRIDAY. PLEASE ADVISE IF YOU WANT TO RECEIVE THIS.

4) AT A LATER TIME WE WILL BEGIN TO REPORT THE WATER LEVEL RELATED TO THE DATUM ON THE MACKENZIE HYDROGRAPHIC CHARTS. THIS WILL BE UNDER THE COLUMN MARKED ''DATUM'' IN THE REPORT TABLE ABOVE. WE WILL CONTINUE TO REPORT THE STAGE IN RELATION TO OUR GAUGE DATUMS AS BEFORE.

A.G. REDSHAW
CHIEF, NWT PROGRAMS
YELLOWKNIFE



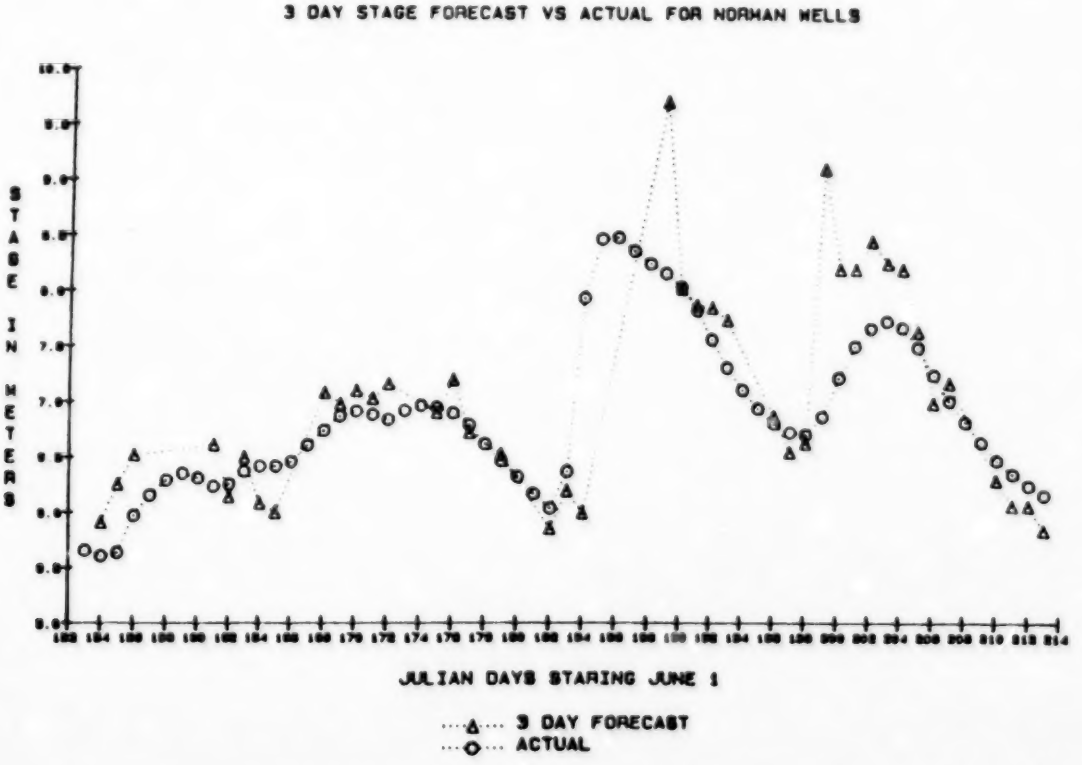


Figure 5: Results of stage forecast during flood of July, 1988, showing relative accuracy during average and high water conditions (note lag due to occurrence of flood over weekend, when no forecast was prepared)

Conclusion

If readers wish to obtain more information about the forecast, please write to the address provided at the beginning of this guide or call the helpful forecast staff identified in the Appendix.

May the 1990 navigation season keep the paint on your keel!

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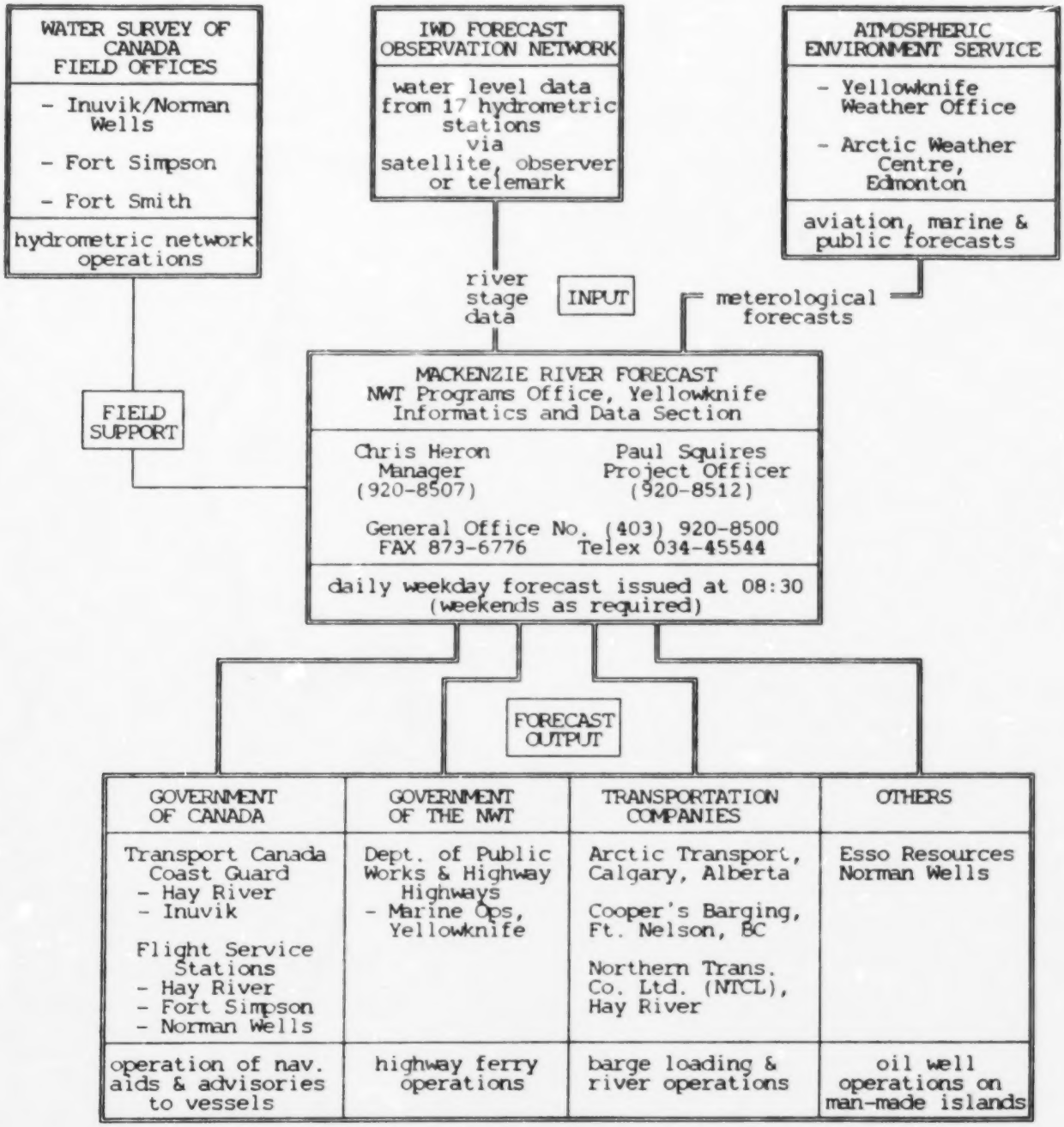
N.W.T. Programs
Inland Waters Directorate
Western & Northern Region

MACKENZIE RIVER STAGE FORECAST

FLOWCHART



Canada

JUNE 1990

APPENDIX

Table A.1 Inland Waters Directorate, Environment Canada

1990 CONTACT LIST FOR

THE MACKENZIE RIVER STAGE FORECAST

DATA SOURCES:

WSC Offices

- Fort Smith, Officer-in-Charge, Murray Jones	Phone 874-2158 FAX 874-2028
- Fort Simpson, Officer-in-Charge, Pat Wood	Phone 695-2621 FAX 695-3122
- Inuvik/Norman Wells, Officer-in-Charge, Herb Wood	Phone 979-2621 FAX 979-4431

AES Yellowknife Weather Office

- Officer-in-Charge, Gary Burke	Phone 873-4020 FAX 920-2247
- Weather Briefings	
. Aviation/Public	Phone 873-4027
. Weather Recording	Phone 873-2734

FORECAST PREPARATION & DISTRIBUTION:

IWD Yellowknife Office

- Chris Heron, Manager Data & Informatics	Phone 920-8507
- Paul Squires, Project Officer	Phone 920-8512
- General Office	Phone 920-8500 FAX 873-6776 Telex 034-45544

MACKENZIE FORECAST CLIENTS AND DISTRIBUTION:

GOVERNMENT OF CANADA - Transport Canada

Canada Coast Guard

. Hay River, E. Krugal	Phone 874-5501 FAX 874-5508
. Inuvik Marine Radio	Telex 034-44589

Flight Service Stations (FSS)

. FSS Hay River	Phone 874-2441 Telex 034-4315
. FSS Fort Simpson	Phone 695-2491 Telex 034-4335
. FSS Norman Wells	Phone 587-2555 Telex 034-46539

GOVERNMENT OF THE NWT

Department of Public Works & Highways

. Marine Operations, Russ Wiggs, Yellovknife	FAX 920-2565
. Marine Operations, Inuvik	FAX 979-4290

TRANSPORTATION COMPANIES

. Coopers Barging, Fort Nelson	Phone (604) 774-6659 FAX (604) 774-6744
. Arctic Transport, Calgary, R. Frieze	Phone 234-7524 FAX 264-9972
. Northern Transportation Co, Ltd. (NTCL), J. Smith, Hay River	Phone 874-2442

OTHERS

. Esso Resources, J. Symes, Norman Wells	Phone 587-3251 FAX 587-3270

APRIL 1, 1990

Table A.2

EMERGENCY PREPAREDNESS CANADA

EMERGENCY CALL CARD

FEDERAL DEPARTMENTS - NORTHWEST TERRITORIES

EMERGENCY PREPAREDNESS CANADA (EPC)

ALBERTA/ NWT	Regional Office	Edmonton	403 495-3005	495-4492	24 hrs
OTTAWA	Situation Centre Conference Bridge	Ottawa	613 991-7000	996-0995	24 hrs

FEDERAL DEPT	NAME	LOCATION	AREA CODE	OFFICE	FAX	RESIDENCE
CASB	Cdn Aviation Safety Board	West Region-NWT - Edmonton	403	495-3999	495-2079	24 hrs
		Central Region-NWT - Winnipeg	204	983-8338	983-8026	24 hrs
		Eastern Region-NWT - Montreal	514	633-3246		24 hrs
CBC	FALCONER, A	Yellowknife	403	920-5400	873-2213	873-3946
	MACKIE, C	"	"	920-5400		920-4349
CC	REIN, T.F.	Yellowknife	403	920-6603	920-6601	920-4321
	SIEMANN, R.H.	"	"	920-6603	873-3410	
CMHC	SODERBERG, J.L.	Yellowknife	403	873-2637	873-6307	873-5431
COGLA	THOMAS, M.D.	Yellowknife	403	920-8178	873-8707	873-4250
	SCRATCH, D.	"	"	920-8176		920-4122
DFO	FISHER, E.	Yellowknife	403	920-5541	873-8071	873-6510
	ARCHIBALD, D.	Hay River	403	874-2331	874-6922	874-6585
	ROBINSON, M.	Inuvik	403	979-3314	979-4330	979-4553
	WEBER, C.	Rankin Inlet	819	645-2871	645-2800	645-2086
	ALLEN, R.	Iqaluit	819	979-6274	979-4539	979-6467
DIAND	ROTHWELL, B.	Ottawa	819	953-8020	819 997-0511	613 591-3819
DIAND/ NAP	STEPHEN, Dr. W.J.	Yellowknife	403	920-8111	873-8114	920-4269
	PALENAUDE, G.	"	"	920-8117		873-3797
DND	WRNQ	Yellowknife	403	873-4011	873-4011	24 hrs
EC/AES	AB Weather Ctr	Edmonton	403	468-7931/30	468-7916	24 hrs
EC/EPS	BONARTH, B.	Yellowknife	403	873-3656	873-8185	873-5145
	TILDEN, D.C.	"	"	873-3656		873-2509
EC/IWD	REDSHAW, A.	Yellowknife	403	920-8500	873-8077	873-4280
	McDONALD, R.S.	"	"	920-8505		873-3707
	JONES, H.	Ft. Smith	403	872-2158		872-3415
	WOOD, P.	Ft. Simpson	403	695-2259	695-3122	695-2677
	WOOD, E.	Inuvik	403	979-2621	979-4330	979-2349
EIC	PILON, C.	Yellowknife	403	920-8612	873-3621	873-8330
	KEHOE, T.	Edmonton	403	495-2611	495-2377	437-6900
FMC	McMULLEN, W.A.	Yellowknife	403	873-4492		920-4550
	BAUCKMAN, E.R.	Edmonton	403	495-3183	495-3219	436-2897
RCMP	"G" Division	Yellowknife	403	920-8320/11		24 hrs

FEDERAL DEPT	NAME	LOCATION	AREA CODE	OFFICE	FAX	RESIDENCE
TC/AIR	Western Region-NWT Flight Serv. Stn.	Edmonton	403	890-8386	955-8446	24 hrs
	Central Region-NWT Flight Serv. Stn	Winnipeg	204	983-8407	983-8052	24 hrs
	Eastern Region-NWT Flight Serv. Stn	Montreal (Dorval)	514	633-3345		24 hrs
TC/CCG	MACDONALD, B.	Hay River	403	874-5501	922-2512	874-2903
	COOK, T.	"	"	874-5559		874-2532
GOVERNMENT OF NORTHWEST TERRITORIES - RWO (GNWT/RWO)						
	BUSSEY, B.	Yellowknife	403	920-6133	873-8193	873-8053
	RISPIN, M.	"	"	873-7003		873-5629
			or	873-7554		24 hrs

OIL & HAZARDOUS MATERIAL SPILL RESPONSE - NWT

* SPILL REPORT LINE (403) 920-8130 24 hrs
FAX: (403) 873-5763/ 920-8127

DEPT	SPILL TYPE	CONTACTS		
CCG	1. Marine Casualties, Shipping Related Spills - Eastern Arctic - Ottawa	613	990-5680	24 hrs
	- Western Arctic - Vancouver	604	666-6011	24 hrs
DIAND	2. Spills related to INAC Licensed Land or Water Use Operations/Activities	* Spill Coordinator/Report Line Yellowknife 403 920-8130		24 hrs
EPS	3. Spills Occurring at Federal Facilities, in National Parks or Crown Land, or Waters not Associated with INAC Operations/Activities	Yellowknife 403 873-3456		(Day Only)
		** Edmonton 403 468-8020		24 hrs
GNWT	4. Spills Occurring on Territorial Lands, Communities & Highways	Yellowknife 403 873-7554		(Day Only)

* The 24-hr Spill Report Line will notify the appropriate agencies with respect to spill types numbered 1, 2, 3, and 4.
** EPS alternate 24-hr number.

ADDITIONAL TELEPHONE NUMBERS

TC (CANUTEC) Info Centre	Ottawa	613	996-6666	24 hrs
EARTHQUAKES: Pacific Geoscience Centre		604	356-6500 (Sidney,BC)	24 hrs
ABCB (Radioactive Material), Ottawa		613	995-8479	24 hrs